

## REMARKS

Reconsideration of this application is respectfully requested.

Independent claim 31 is directed to a steering system for a vehicle having first and second steerable rear wheels. The steering system includes an axle having first and second end portions which are suspended by springs and which support the first and second steerable rear wheels of the vehicle. The axle has an intermediate portion which at least partially defines a chamber through which a central axis of the axle extends. A first steerable vehicle wheel is pivotally mounted on a first end portion of the axle. A second steerable wheel is pivotally mounted on a second end portion of the axle.

A steering member is supported in the chamber in the axle and is movable relative to the axle. A ball nut is associated with a screw thread portion of the steering member and is disposed in the chamber in the axle. An electric motor is connected with axle. At least one drive member is connected with the electric motor and the ball nut to rotate the ball nut to move the steering member in the chamber in the axle upon actuation of the electric motor. A takeoff assembly is connected with the steering member and has a portion projecting from an opening in the intermediate portion of the axle.

In addition, claim 31 sets forth a first linkage as being connected with the projecting portion of the takeoff assembly. The first steering linkage extends along an outer side of the axle to transmit movement of the takeoff assembly to the first steerable rear wheel. The first steering linkage is pivotally connected with the first steerable rear wheel to effect pivotal movement of the first steerable rear

wheel about a first pivot axis upon movement of the steering member in the chamber in the axle. A second steering linkage is connected with the projecting portion of the takeoff assembly and extends along the outer side of the axle to transmit movement of the takeoff assembly to the second steerable rear wheel. The second steering linkage is pivotally connected to the second steerable rear wheel to effect pivotal movement of the second steerable rear wheel about the second pivot axis upon movement of the steering member in the chamber in the axle.

Claim 31 was rejected as being unpatentable over a combination of the patents to Ohmura, et al. (5,007,494) and the patent to Cartwright (6,098,742). In rejecting claim 31, the Examiner indicated that the housing 40 of Ohmura, et al. is an axle. It is respectfully submitted that the housing 40 of Ohmura, et al. is not an axle.

In the patent to Ohmura, et al., the end portions of the housing do not support the two rear wheels 6L and 6R. A turning rod 30 (designated by the numeral 46 in the specification) extends through the housing 40 (see Fig. 2 of Ohmura, et al.). In Fig. 3, the turning rod 30 of Ohmura, et al. is clearly illustrated as being offset to the rear of the two wheels 6L and 6R. There is no way that the wheels 6L and/or 6R can be supported by the housing 40 of Ohmura, et al.

If the wheels 6L and 6R of Ohmura, et al. (Fig. 1) rotated about the housing 40 of Ohmura, et al. (Fig. 2), in the manner suggested by the Examiner, the resulting construction would be inoperative. The turning rod 30 (Fig. 2 of Ohmura, et al.) has a central axis which is coincident with the housing 40. In Fig. 1 of the

patent to Ohmura, et al. the turning rod 30 is offset to the rear of the axes about which the wheels 6L and 6R revolve. It is impossible for the wheels 6L and 6R of Ohmura, e al. to revolve about an axis which is coincident with the central axis of the turning bar 30.

The enclosed Patent No. 4,978,131 to Edahiro, et al. is assigned to the same assignee as is the patent to Ohmura, et al., that is, Mazda Motor Corporation. A comparison of Fig. 3 of Edahiro, et al. to Fig. 1 of Ohmura, et al. indicates that they disclose the same general type of steering apparatus. In Fig. 1 of the patent to Edahiro, et al. (4,978,131), the manner in which a steering apparatus is connected with a rear wheel 11R is disclosed. A turning rod 12 (see Fig. 3 of the patent to Edahiro, et al.) is connected with the wheel 11R by a tie rod 13R (Figs. 1 and 3) and a knuckle arm 14R. It is believed to be clear that the wheel 11R (see Fig. 1 of Edahiro, et al.) does not revolve about the tie rod 13R and/or the turning rod 12.

In addition, the Examiner's attention is directed to the enclosed patent to Kondo, et al. (5,080,185). The patent to Kondo, et al. is assigned to the same assignee as the patent to Ohmura, et al., that is, to Mazda Motor Corporation. Fig. 3 of the patent to Kondo, et al. discloses the manner in which a steerable rear wheel 3R is rotatably supported and is connected with a steering linkage. The Examiner's attention is directed to the description at column 4, lines 16 – 65 of the patent to Kondo, et al. A comparison of Fig. 1 of the patent to Kondo, et al. (5,080,185) to Fig. 1 of Ohmura, et al. (5,007,494) indicates that they disclose the same general type of steering apparatus. It is believed to be very clear that a

housing for the turning rod 15 (Figs. 3 and 4) can not form an axle for the rear wheel 3R.

Applicants have submitted a PTO-1449 making the patents to Edahiro, et al. (4,978,131) and Kondo, et al. (5,080,185) of record. Other patents disclosing the relationship between an axle, a wheel and a steering mechanism have also been made of record in the PTO-1449. In regard to the additional patents cited in the PTO-1449, the patent to Mitchell (5,219,176) discloses an axle 18, the patent to Tandy, et al. (5,636,857) discloses an axle 12, the patent to Rohweder, et al. (5,820,147) discloses an axle 12, the patent to Dudding, et al. (6,616,156) discloses axles 22 and 102, and the patent to Ima (6,202,781) discloses an axle case 1. It is believed that it will be clear from the disclosures in these patents of wheels and axles that the housing 40 of Ohmura, et al., which encloses the turning rod 42 (designated by the numeral 30 in Fig. 2 of the Ohmura, et al. drawings), is not an axle.

Claim 31 was rejected as being unpatentable over a combination of the patents to Ohmura, et al. (5,007,494) and Cartwright (6,098,742). The drawings in the patent to Ohmura, et al. does not illustrate an axle. However, the drawings in the patent to Cartwright do illustrate an axle.

The axle of Cartwright is designated by the numeral 56 in Fig. 2. The steering apparatus 10 is mounted on the axle 56 of Cartwright by a pair of bands which are disposed at opposite ends of the steering apparatus. Therefore, the patent to Cartwright clearly teaches that the steering apparatus is to be mounted on the outside of the axle and is not to be mounted in a chamber in the axle.

Since an axle is not shown in the patent to Ohmura, et al., a combination of the disclosures of Ohmura, et al. and Cartwright, would result in the steering apparatus of Ohmura, et al. being mounted on the outside of the axle of Cartwright, in the manner illustrated in Fig. 2 in the patent to Cartwright.

In addition, claim 31 defines over a combination of the patents to Ohmura, et al. and Cartwright by setting forth a takeoff assembly connected with a steering member and having a portion projecting from an opening in an intermediate portion of an axle. It is believed to be clear that the patent to Ohmura, et al. does not disclose a takeoff assembly which is connected with a steering member and has a portion projecting from an intermediate portion of an axle. If the housing 40 for the steering rod 30 of Ohmura, et al. is to be considered as an axle, which it is not, there is no takeoff assembly having a portion projecting from an opening in an intermediate portion of the housing (axle). Although Ohmura, et al. does disclose a turning angle sensor 120 mounted on the housing 40, the turning angle sensor 120 of Ohmura, et al. does not have a first steering linkage connected with the projecting portion of a takeoff assembly and a second steering linkage connected with the projecting portion of the takeoff assembly.

If the turning rod housing 40 of Ohmura, et al. is considered to be an axle, which it is not, there is no disclosure in the patent to Ohmura, et al. of first and second steering linkages which extend along the outer side of the axle. If the disclosure in the patent to Cartwright is combined with the disclosure in the patent to Ohmura, et al., there is nothing which teaches positioning a steering member in a chamber in an axle. The turning rod 30 (referred to by the numeral 46 in the

specification of Ohmura, et al.) is not disposed in a chamber in an axle. The steering apparatus 12 of Cartwright is not disposed in the axle 56. Therefore, a combination of the disclosures in the patents to Ohmura, et al. and Cartwright can not result in a steering member being disposed in a chamber in an axle.

Claims 32 through 44 depend from claim 31 and define over the prior art for substantially the same reasons as does claim 31 and by virtue of the structure and function set forth in these claims taken in combination with the structure and function of claim 31. Specifically, claim 32 sets forth a spring assembly as being disposed in a chamber in the axle to bias a steering member toward a straight-ahead position. The rear wheel neutralizing mechanism 36 of Ohmura, et al. does include a spring 98. However, the spring 98 of Ohmura, et al., is not disposed in a chamber in an axle. Since the rear wheel neutralizing mechanism 36 of Ohmura, et al. is clearly disposed in Fig. 1 as being rearwardly of the center lines of the wheels 6L and 6R, it is clear that the rear wheel neutralizing mechanism 36 is not disposed in an axle for the rear wheels.

Claim 33 depends from claim 31 and sets forth a spring assembly as being disposed in a chamber of the axle. The spring assembly includes a single spring which acts to bias the steering member toward a straight-ahead position. The rear wheel neutralizing mechanism 36 of Ohmura, et al. is not disposed in a chamber in an axle in the manner set forth in claim 33.

Claim 34 depends from claim 33 and sets forth fixed stops as being disposed in the chamber in the axle. The steering member has movable stops

that are movable relative to the fixed stops. The stoppers 90 and 92 of Ohmura, et al. are not disposed in a chamber in an axle in the manner set forth in claim 34.

Claim 35 depends from claim 31 and sets forth a spring assembly as being disposed in a chamber in an axle. A takeoff assembly includes a piston which is located between the ball nut and the spring assembly. The spring assembly is effective to urge the takeoff assembly toward a straight-ahead position. The patent to Ohmura, et al. and/or the patent to Cartwright do not disclose or even remotely suggest having a piston located between a ball nut and a spring assembly in a chamber of an axle.

Claim 36 depends from claim 35 and sets forth a stop means as being spaced apart from the piston and acting between a spring and a spring assembly and the steering member for transmitting bias force of the spring to the steering member.

Claim 39 depends from claim 31 and sets forth a motor control system which is operative to enable the generation of back EMF upon movement of the steering member toward a straight-ahead position in order to resist movement of the steering member toward the straight-ahead position. Applicant's attorneys have reviewed the patent to Ohmura, et al. and can not find any reference to the generation of back EMF in a motor to resist movement of a steering member toward a straight-ahead position. In rejecting claim 39, the Examiner indicated that this was disclosed at "columns 3 – 5, lines 53 – 10". Applicant's attorney can not any reference anywhere in columns 3 – 5 of Ohmura, et al. of generating back EMF with a motor.

Claim 40 depends from claim 31 and sets forth the electric motor as being located outside the chamber in the axle. The drive member extends through an opening formed in the axle. It is respectfully submitted that the housing 40 of Ohmura, et al. is not an axle.

Claim 41 depends from claim 31 and sets forth the steering member as being free of rack teeth. The Examiner's attention is directed to the fact that the turning rod 46 (designated by the numeral 30 in Fig. 2) is provided with "a rack 140".

Claim 42 depends from claim 31 and sets forth the electric motor as being effective to resist movement of the steering member toward a straight-ahead position. Applicant's attorneys do not understand how the servomotor 32 of Ohmura, et al. is to be construed as resisting movement of a steering member toward a straight-ahead position.

Claim 43 depends from claim 32 and sets forth a locking member for locking the steering member in a straight-ahead position. The patent to Ohmura, et al. discloses a brake 46 which locks the output shaft 32a of the servomotor 32. The brake 46 does not lock the steering member in a straight-ahead position.

Claim 44 depends from claim 31 and sets forth a drive member as being a belt which extends partway around the ball nut and part way around an output member which is connected with the electric motor.

Independent claim 58 is directed to a steering system for a vehicle having first and second steerable rear wheels. The steering system includes an axle having first and second end portions which are suspended by springs which



support first and second steerable rear wheels of the vehicle. The first and second steerable rear wheels are rotatable about the longitudinal central axis of the axle when the first and second steerable rear wheels are in a straight-ahead condition. A steering member has a longitudinal central axis which is coincident with the longitudinal central axis of the axle so that the first and second steerable rear wheels are rotatable about the longitudinal central axis of the steering member when the first and second steerable rear wheels are in a straight ahead condition. The steering member supported in a chamber in the axle for axial movement relative to the axle. The steering member has a screw thread portion.

The ball nut is set forth in claim 58 as being associated with the screw thread portion of the steering member and disposed in the chamber in the axle. An electric motor is connected with the axle. At least one drive member is connected with the electric motor in the ball nut to rotate the ball nut to move the steering member in the chamber in the axle upon actuation of the electric motor. A takeoff assembly is connected with the steering member and has a portion projecting from an opening in the intermediate portion of the axle at a location midway between the first and second end portions of the axle.

A first steering linkage is set forth in claim 58 as being connected with the projecting portion of the takeoff assembly and as extending along an outer side of the axle to transmit movement of the takeoff assembly to the first steerable rear wheel. The first steering linkage being pivotally connected to the first steerable rear wheel to effect pivotal movement of the first steerable rear wheel about the first pivot axis upon movement of the steering member in the chamber in the axle.

A second steering linkage is connected with the projecting portion of the takeoff assembly and extends along the outer side of the axle to transmit movement of the takeoff assembly to the second steerable rear wheel. The second steering linkage is pivotally connected to the second steerable rear wheel to effect movement of the second steerable rear wheel about the second pivot axis upon movement of the steering member in the chamber in the axle.

Claim 59 defines over the prior art, and particularly the patents to Ohmura, et al. (5,007,494) and Cartwright (6,098,742), by setting forth the first and second steerable rear wheels as being rotatable about the longitudinal central axis of the axle when the first and second steerable rear wheels are in a straight ahead condition. The patent to Ohmura, et al., the turning rod 30 (referred to by the numeral 46 in the specification) is offset to the rear of the axes about which the wheels 6L and 6R rotate (see Fig. 1 of Ohmura, et al.). The housing 40 of Ohmura, et al. (Fig. 2) does not function as an axle.

The steering member is set forth in claim 58 as having a longitudinal central axis which is coincident with the longitudinal central axis of the axle so that the first and second steerable rear wheels are rotatable about the longitudinal central axis of the steering member. In the patent to Ohmura, et al. the turning rod (represented by the numeral 46 in the specification) has a central axis which is offset rearward from the axis about which the wheels 6L and 6R rotate. Therefore, it is impossible for the turning rod 30 of Ohmura, et al. to have a central axis which is coincident with the longitudinal central axis of the axle in the manner set forth in claim 58.

Claim 59 depends from claim 58 and defines over the prior art for substantially the same reasons as does claim 58 and by virtue of the structure and function set forth in claim 59 taken in combination with the structure and function of claim 58. Specifically, claim 59 sets forth the motor control system which enables generation of back EMF in an electric motor upon movement of the steering member toward the straight ahead position. The patent to Ohmura, et al. discloses an electric motor 32. However, the patent to Ohmura, et al. does not disclose generating back EMF in the motor to resist movement of a steering member toward a straight ahead position. The patent to Ohmura, et al. discloses a brake 46. Thus, the patent to Ohmura, et al. states:


When the rear wheel turning rod 46 is fixed by the brake 46, the power consumption is reduced compared to when it is fixed by the servomotor (column 3, lines 67 and 68 and column 4, lines 1 and 2 of Ohmura, et al.

Quite clearly Ohmura, et al. relies on the brake 46 to resist movement of the steering member toward the straight-ahead position.

In view of the foregoing remarks, it is believed that the claims in this application clearly and patentably define over the prior art. Therefore, it is respectfully requested that the claims be allowed and this application passed to issue.

If for any reason the Examiner believes that a telephone conference would expedite the prosecution of this application, it is respectfully requested that the Examiner call applicant's attorneys in Cleveland, Ohio at 621-2234, area code 216. Please charge any deficiency in the fees for this application to our Deposit Account No. 20-0090.

Respectfully submitted,

  
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